H2020-MSCA-RISE-2015 – Grant Agreement N° 690835

MUSE overview

S. Giovannella (INFN-LNF)

MUSE General Meeting
Frascati, 23-25 October 2019

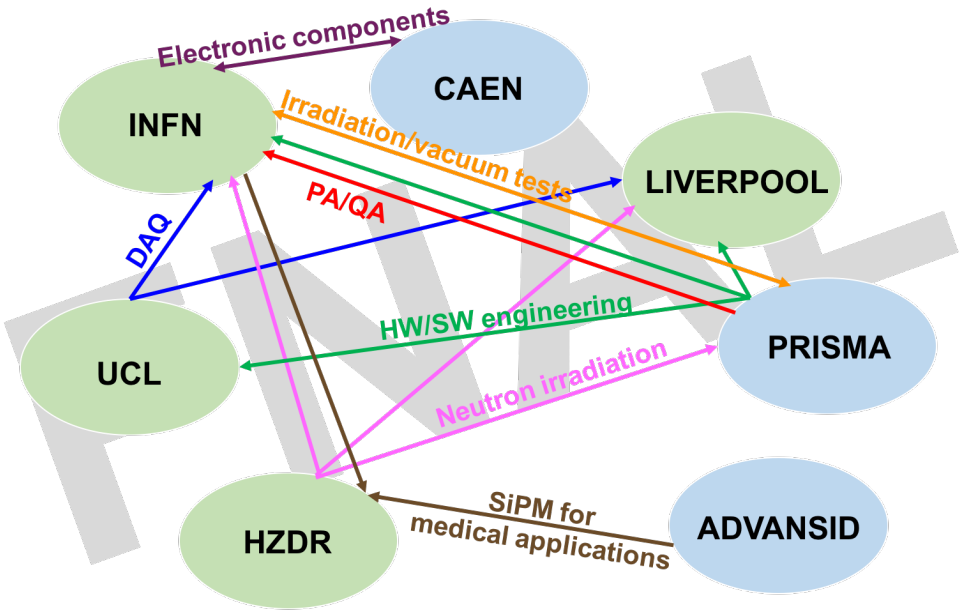
MUSE and the Muon Campus

Last General Meeting was one year ago at Fermilab. In the meanwhile:

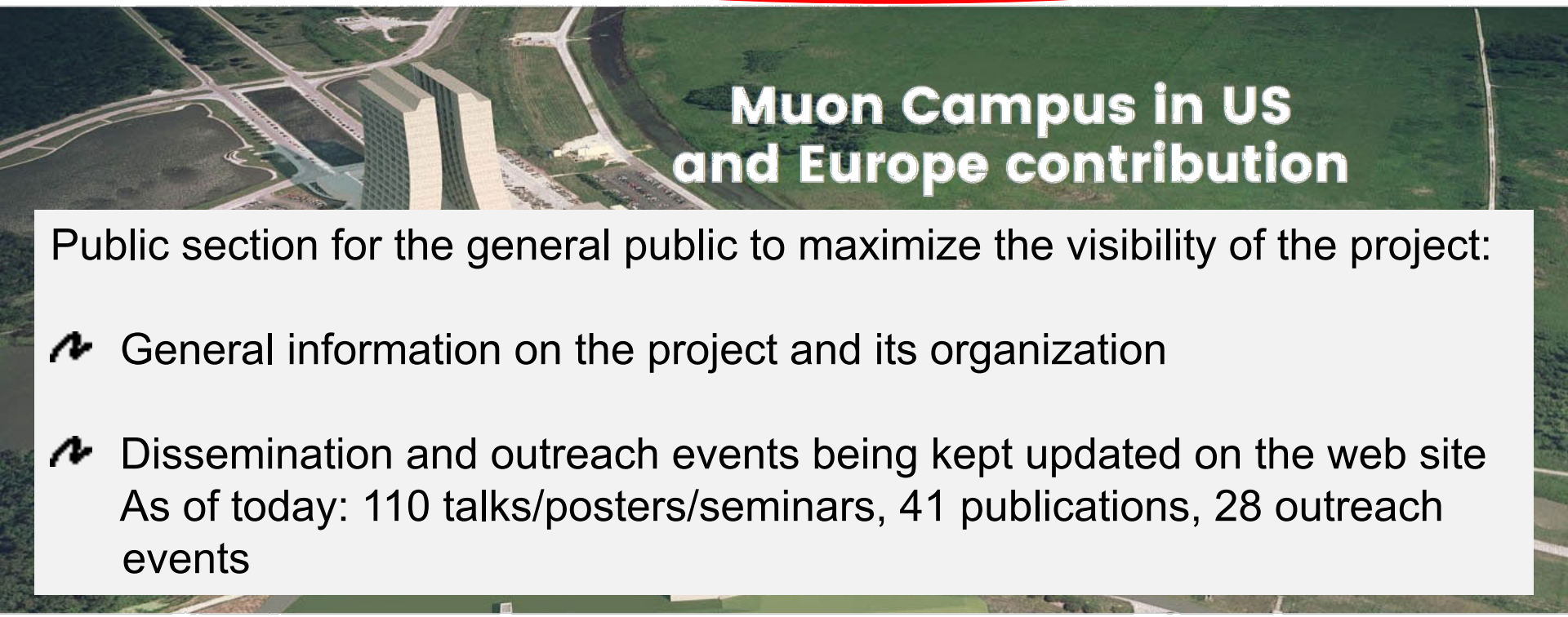
- ✗ Muon Campus activities are progressing steadily, as well as MUSE tasks
- ✗ All of the 26 deliverables submitted
- ✗ Progress reports with updates released every 6 months
- ✗ Governing boards meetings regularly done
- ✗ Dissemination
- ✗ Outreach
- ✗ Networking

Several events organized

MUSE website is the right place where to find documentation for all of this



Web site: http://muse.lnf.infn.it



Public section for the general public to maximize the visibility of the project:

- General information on the project and its organization
- Dissemination and outreach events being kept updated on the web site
  As of today: 110 talks/posters/seminars, 41 publications, 28 outreach events

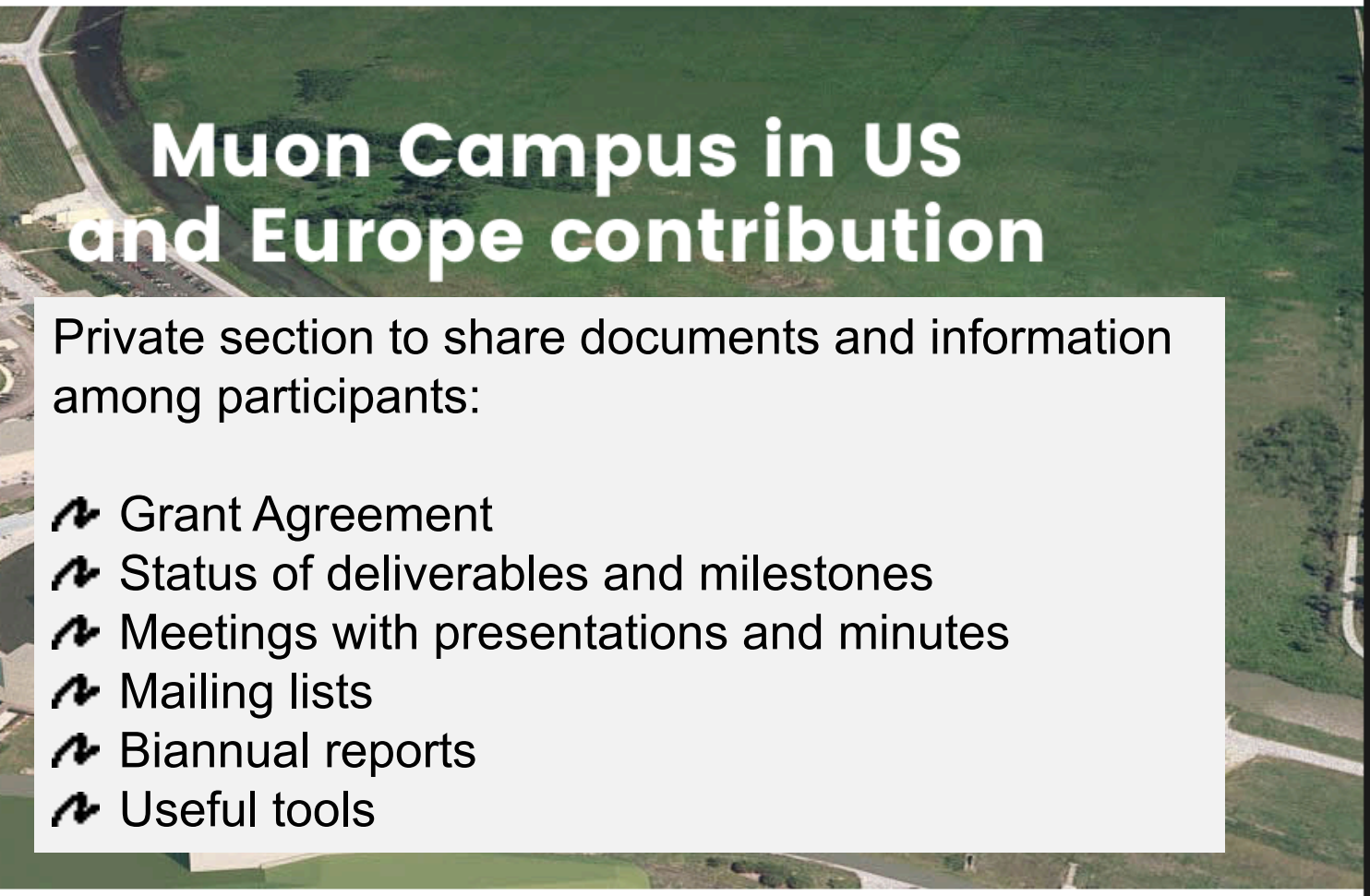
ABOUT MUSE PROJECT

The MUSE project coordinates the activities of about 70 researchers from various European research institutes and industries for the participation to the experiments at the Muon Campus of the Fermi National Laboratory, USA. It promotes international and intersectoral collaboration by means of secondments of personnel, thus enhancing European contribution and visibility in this activity.

The duration of the MUSE project is of four years, thus well adapting to the Muon Campus schedule that will host in the same period two world class experiments dedicated to the search of new physics: Muon g-2, for a ten-fold improvement on the measurement of the muon magnetic anomaly, and Mu2e, for the search of the yet unobserved conversion of a muon to an electron.

Web site: http://muse.lnf.infn.it

PROJECT DISSEMINATION OUTREACH PARTNERS ORGANIZATION CONTACTS



Private section to share documents and information among participants:

- Grant Agreement
- Status of deliverables and milestones
- Meetings with presentations and minutes
- Mailing lists
- Biannual reports
- Useful tools

INTERNAL MENU

- Grant Agreement
- Deliverables
- Milestones
- Meetings
  - Internal
  - Management Board
  - Scientific Board
- Mailing lists
- Reports
- MUSE logo
- Acknowledgements
- Templates
- Logout

WP activities

MUSE activities are organized in seven Work Packages (WP):

WP1	WP2	WP3	WP4	WP5	WP6	WP7
g-2 detectors	Mu2e detectors	Calibration	Software tools	Dissemination & outreach	Transfer of knowledge	Management

✗ Scientific activities related to g-2 and Mu2e are included in WP 1-4:

✗ In general, tasks of WP 1-4 are proceeding smoothly:

- g-2 is starting its third data taking campaign
- Mu2e construction phase in full swing

✗ Most of the agenda of this 2019 General Meeting is focused on this

✗ I will mostly address/discuss what's going on in WP 5-6-7

WP5: Dissemination and Outreach

WP Leaders: A. Lusiani
D. Glenzinski

- ✗ Lot of effort in dissemination and outreach activities
- ✗ List of public events on the MUSE web site
- ✗ MUSE results disseminated to the international scientific community through the participation to physics and instrumentation international conferences and the publication in professional journals:
  - 110 talks delivered
  - 41 publications produced (all gold/green open access)
- ✗ Outreach events, promoting communication between MUSE scientific community and general public to increase science awareness and to inspire the next generations of scientists:
  - Training courses for FNAL Summer Students
  - MUSE General Meeting: Outreach event for University students
  - Open Day and European Researchers' Night
  - Other specific events in different MUSE institutions

2019 FNAL Outreach event

Lectures

Tuesday, August 13, 2019 – Curia II, Wilson Hall, 2nd floor

14:00 - 14:45	C. Polly	"Overview of the Muon (g-2) experiment at FNAL"
14:45 - 15:30	B. Casey	"The tracker of the Muon (g-2) experiment at FNAL"
15:30 - 15:40	break	
15:40 - 16:15	C. Stoughton	"How to kick 200,000 muons per second into a storage ring"
16:15 - 16:50	J. Price	"How to measure the muon spin precession frequency to 100 ppb"

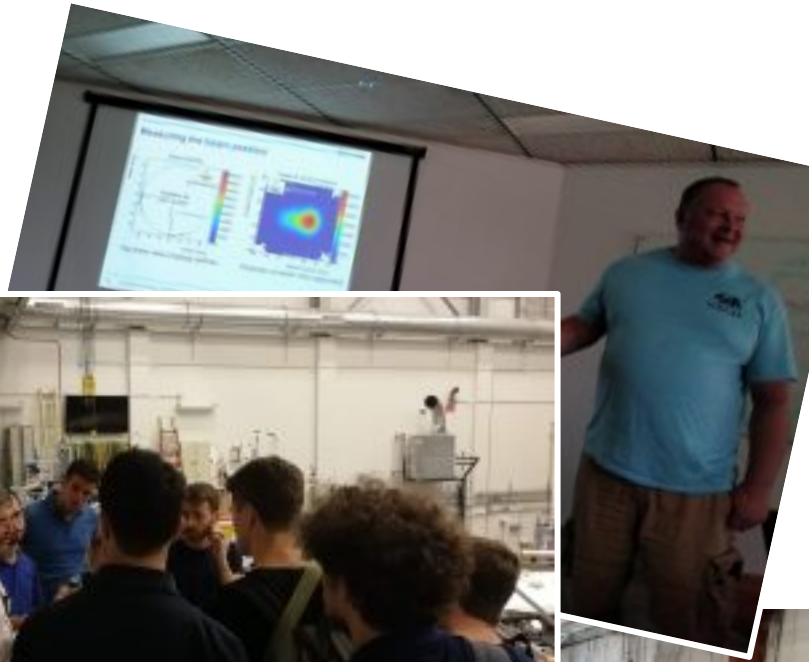
Visits

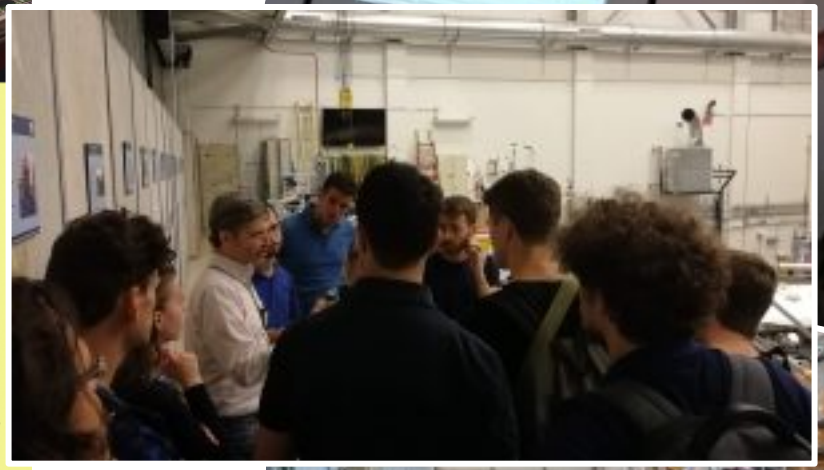
Friday, August 9, 2019 – Meeting point: MC-1 building entrance (Muon g-2 experiment)

15:30 – 16:40 Guided tour to the Muon g-2 and Mu2e experiments

MUSE Fermilab

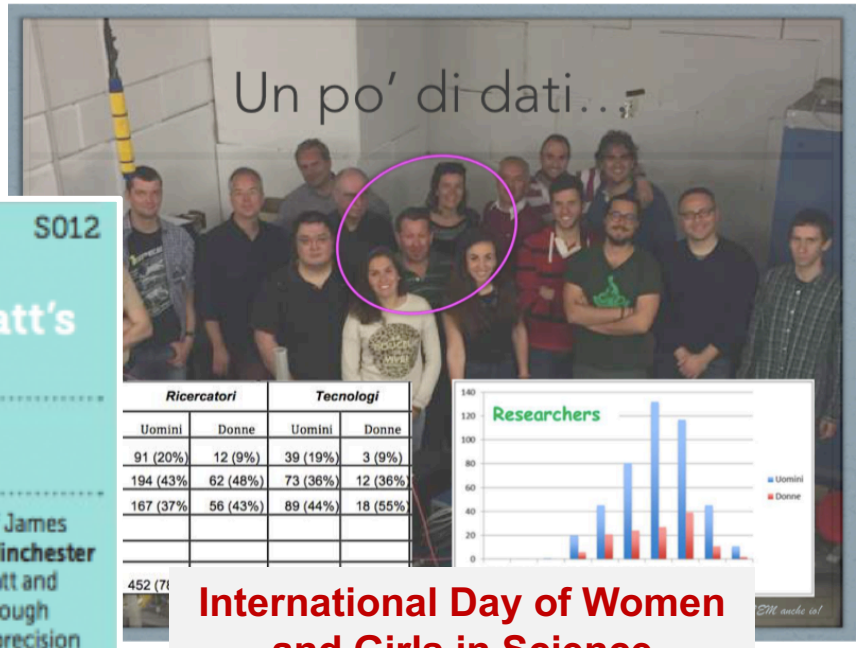
Last edition of MUSE Lectures from FNAL Summer Students





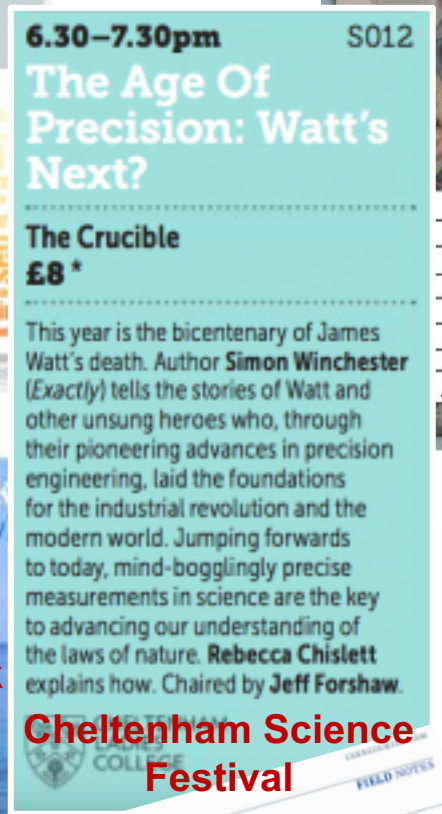
2019 EU outreach events

INSPYRE 2019



International Day of Women and Girls in Science

Muon g-2 Physics Week



Cheltenham Science Festival

GM 2019 Outreach event

WP6: Transfer of Knowledge

- **Objectives**: coordination of the activities dedicated to the training of research and industry personnel to achieve a substantial ToK among participants and to increase the quality of the research and the competitiveness of the partners

WP Leaders: F. Spinella
A. Ferrari

- **Tasks**: (6.1) research-industry ToK; (6.2) medical applications; (6.3) training

- **Activities on research-industry Transfer-of-Knowledge**:
  - CAEN secondments to FNAL completed in July 2018
  - INFN-PRISMA secondments restarted after ~ 1 year stop
    - 1 PRISMA-LNF secondment (Jul 2019) – QA expert
      Workflow of QA procedures for Mu2e readout electronics
    - 1 LNF-PRISMA secondment (Aug 2019) – Researcher
      Test of Mu2e calorimeter photo-sensors in a climate chamber

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- **Tasks**: (6.1) research-industry ToK; (6.2) medical applications; (6.3) training

- **Training**:
  - training courses during General Meetings on specific advanced topics from research development in HEP or industry
  - attendance of schools for PhD and postdocs
  - technical training courses
  - soft skills training courses (management, science communication, language…)

37 events listed listed since MUSE started, more than 70 researchers involved + GM events

WP6: Medical Applications

Involved institutes: HZDR, ADVANSID, INFN

Goal: transfer of the INFN and ADVANSID expertize on SiPM to the HZDR med. group

- ✗ Medical Physics group dissolved in 2017 + re-employment in other activities of the personnel involved in MUSE
- ✗ Impossible to benefit of the secondments to AdvanSid
- ✗ Mitigation plan:
  1. collaboration with the Dresden University Proton Therapy Center and the National Center for Radiation Research in Oncology (OncoRay) to continue medical application activities, although with a narrower horizon
  2. Researchers involved in WP4 gained expertize on SiPM developments
- ✗ **Deliverable D6.2, "SiPM characterization" submitted** on Oct 16 2019:
  - Development of a gamma slit camera with SiPM readout for hadron therapy
  - SiPM developments for Nuclear Physics sector
  - SiPM readout calorimeters for high-power laser-plasma experiments

MUSE irradiation network

Existing European infrastructures used to carry on an irradiation program among MUSE participants (HZDR, INFN, LIVERPOOL, PRISMA), aiming to test radiation hardness and characterize detector components of the Mu2e detectors

Among them, the ELBE accelerator complex at HZDR provides both high dose neutron flux (pELBE) and high-intensity Bremmstrahlung radiation (gELBE)

Other irradiation sources: FNG (ENEA Frascati – 14 MeV neutrons) and CALLIOPE (ENEA Casaccia – 1.25 MeV photons)

- Several irradiation tests for R&D of Mu2e calorimeter electronics in the last year

- QA of SiPM for the Mu2e calorimeter: passive neutron irradiation for production components on random samples

WP7: Management

Objectives: efficient, transparent and productive organization of the project; supervision of secondments; monitoring of the the scientific activities and of the fulfilment of the deliverables; maximization of the knowledge sharing among the involved institutions; equal opportunity for all participants and maximization of the visibility of the project.

Task 7.1: Project supervision: planning, authorization and supervision of secondments; monitoring of the Work Packages activities and deliverables/milestones.
MS8 (M1) – Management structure in place

Task 7.2: Planning and organization of meetings: Management Board, Scientific Board and Annual General Meetings
D7.4/7.5/7.6/7.7 (M9/21/33/45) MUSE General Meetings

Task 7.3: Periodic written reports on the ongoing WP activities and on the status of secondments and milestones/deliverables
D7.1 (M12) First progress report
D7.2 (M36) Second progress report

Task 7.4: MUSE web site, organized with a private section for the participants and pages for general public
D7.3 (M5) MUSE web site

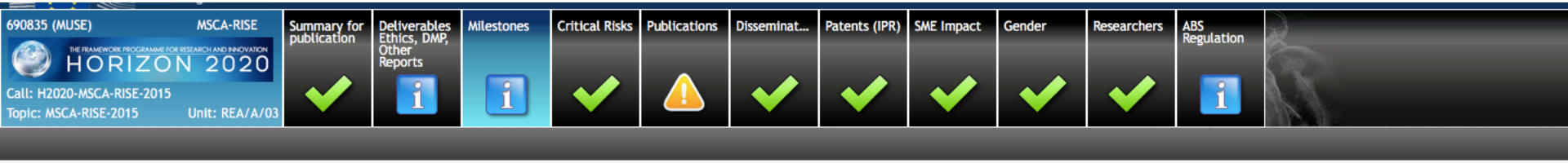
MUSE Deliverables

Deliverables, Ethics, DMP, Other Reports for Project 690835

Deliverables, Ethics, DMP, Other Reports										
WP No	Del Rel. No	Title	Description	Lead Beneficiary	Nature	Dissemination Level	Est. Del. Date (annex I)	Receipt Date	Approval Date	Status
WP1	D1.1	Report on laser integration	Report on assembly	INFN	Report	Public	31 Dec 2017	12 Jan 2018	20 Mar 2018	Approved
WP1	D1.2	Report on g-2 trackers	Report on installatio	LIVERPOOL	Report	Public	31 Dec 2017	31 Dec 2017	20 Mar 2018	Approved
WP2	D2.1	Calorimeter TDR	Technical Design Re	INFN	Report	Public	31 Dec 2016	28 Dec 2016	20 Mar 2018	Approved
WP2	D2.2	Production DB	Database of calorim	INFN	Other	Public	31 Dec 2018	15 Dec 2018		Submitted
WP2	D2.3	Mu2e HPGe design	Design of HPGe det	LIVERPOOL	Report	Public	31 Mar 2018	29 Mar 2018		Submitted
WP3	D3.1	g-2 laser calibration system	Final design of the g	INFN	Other	Public	31 Oct 2016	17 Mar 2017	20 Mar 2018	Approved
WP3	D3.2	g-2 tracker tools	Software alignment a	UCL	Report	Public	30 Jun 2017	04 Jul 2017	20 Mar 2018	Approved
WP3	D3.3	Mu2e laser system	Final design of Mu2e	INFN	Report	Public	30 Jun 2017	13 Oct 2017	20 Mar 2018	Approved
WP4	D4.1	Mu2e code	Mu2e calorimeter, H	INFN	Other	Public	31 Aug 2018	31 Aug 2018		Submitted
WP4	D4.2	g-2 full muon simulation	Simulation of 10^11	UCL	Report	Public	31 Dec 2016	30 Dec 2016	20 Mar 2018	Approved
WP5	D5.1	MUSE @ HZDR open day	MUSE laboratories c	HZDR	Other	Public	30 Sep 2016	17 Mar 2017	20 Mar 2018	Approved
WP5	D5.2	Annual Physics Meetings	Experiments prepare	INFN	Other	Public	31 Oct 2017	17 Oct 2017	20 Mar 2018	Approved
WP5	D5.3	Masterclasses	Masterclasses for hi	LIVERPOOL	Other	Public	30 Apr 2018	30 Apr 2018		Submitted
WP5	D5.4	FNAL Summer School	Three-day training o	INFN	Other	Public	31 Aug 2019	27 Aug 2019		Submitted
WP6	D6.1	Irradiation tests	Report on irradiatio	INFN	Report	Public	30 Nov 2018	30 Nov 2018		Submitted
WP6	D6.2	SiPM characterization	Report on SiPM cha	HZDR	Report	Public	31 Dec 2018	15 Oct 2019		Submitted
WP7	D7.1	First progress report	Periodic report on th	INFN	Report	Confidential, only for	31 Dec 2016	30 Dec 2016	20 Mar 2018	Approved
WP7	D7.2	Second progress report	Periodic report on th	INFN	Report	Confidential, only for	31 Dec 2018	30 Dec 2018		Submitted
WP7	D7.3	MUSE web site	Project web site, bot	INFN	Websites, patents fil	Public	31 May 2016	17 Mar 2017	20 Mar 2018	Approved
WP7	D7.4	1st MUSE general meeting	2016 MUSE general	INFN	Other	Public	30 Sep 2016	17 Mar 2017	20 Mar 2018	Approved
WP7	D7.5	2nd MUSE general meeting	2017 MUSE general	INFN	Other	Public	30 Sep 2017	01 Aug 2017	20 Mar 2018	Approved
WP7	D7.6	3rd MUSE general meeting	2018 MUSE general	INFN	Other	Public	30 Sep 2018	27 Sep 2018		Submitted
WP7	D7.7	4th MUSE General Meeting	2019 MUSE general	INFN	Other	Public	30 Sep 2019	27 Sep 2019		Submitted
WP8	D8.1	NEC - Requirement No. 3	The applicant must c	INFN	Ethics	Confidential, only for	31 Jan 2016	20 Jan 2016	20 Jan 2016	Approved
WP8	D8.2	NEC - Requirement No. 2	The applicant must p	INFN	Ethics	Confidential, only for	31 Jan 2016	20 Jan 2016	20 Jan 2016	Approved
WP8	D8.3	NEC - Requirement No. 1	The applicants must	INFN	Ethics	Confidential, only for	31 Jan 2016	20 Jan 2016	20 Jan 2016	Approved

- ✓ All of the 26 deliverables submitted
- ✓ Only two of them with some significant delay

MUSE Milestones



Milestones SAVE

Number	Name	Lead Beneficiary	Delivery Date (Annex I)	Achieved	Delivery Date (actual)	Comments
1	Tracker-DAQ integration	UCL	31 May 2017	☑	10 Apr 2017	DAQ integrated. The experiment begins DAQ operations on 01 May 2017.
2	First EMC disk assembled	INFN	30 Jun 2019	☐		
3	HPGe detector installed	UCL	31 Dec 2019	☐		
4	Mu2e laser assembled	INFN	30 Jun 2018	☑	15 May 2018	Mu2e laser system assembled and tested in Frascati
5	g-2 calibration commissioned	UCL	31 Dec 2018	☑	01 May 2018	SiPM gain monitoring (in and out of fill) and straw time-to-distance calibration completed and verified with run-1 data.
6	New release of the g-2 softw	UCL	31 Dec 2016	☑	22 Nov 2016	Release of the g-2 simulation code, version V7-03-00
7	Mu2e software running on co	INFN	30 Apr 2019	☑	22 Feb 2019	Mu2e reconstruction code commissioned with cosmic ray events from Mock Data Challenge 2018, and used to develop strategies for the calorimeter in situ calibration
8	Management structure in pla	INFN	31 Jan 2016	☑	11 Jan 2016	Management Boards and Scientific Board members have been appointed

- ✓ 6 milestones completed before deadline
- ✓ Mu2e EMC disk assembly has some delay due to the mechanics
- ✓ HPGe detection installed is due by the end of the project

Secondments Jan 2016-Jun 2019

Institution	Scheduled in GA (Months)	Fraction (days)
ADVANSID	1	--
CAEN	2	128%
HZDR	24	36%
INFN	245	84%
LIVERPOOL	51	65%
PRISMA	22	33%
UCL	40	58%
Total	**385**	**73%**

- ADVANSID secondments will not be done
- CAEN secondments completed

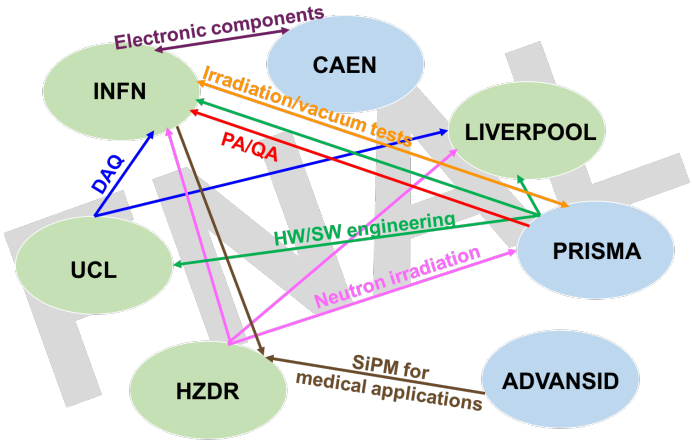
Next steps

What is left to do:

- ✗ Complete secondments, especially those not reaching 30 days
- ✗ 2 milestones to be completed
- ✗ Last Scientific Board meeting, December 2019
- ✗ Final Progress Report, beginning of 2020

MUSE objectives (from MTM)

- ✗ Establish new collaborations among European groups participating in the Muon Campus experiments
- ✗ Increase our presence and visibility at Fermilab, strengthening the already existing partnership with the lab
- ✗ Exploit the existing European infrastructures to create a network of radiation hardness tests and characterization of detector components
- ✗ Transfer of knowledge among partners, exploiting specific competences of MUSE partners
- ✗ Promote inter-sectoral collaborations
- ✗ Use EU funds to increase
  - training, skill development of personnel
  - dissemination activities
  - science communication



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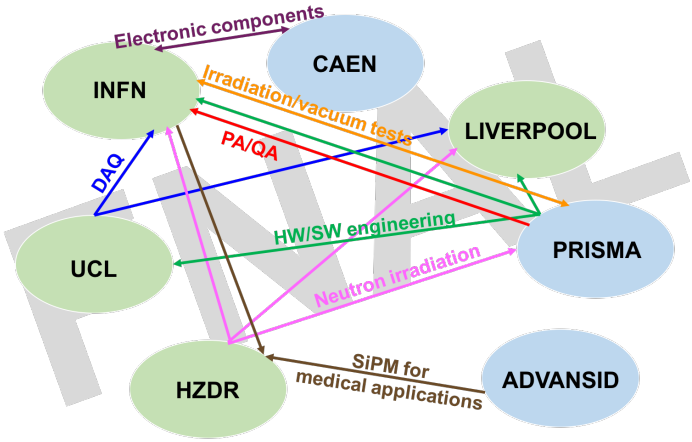
★★★



Conclusions